September 1997

22657-000-0000-30000

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Progress Report on the Investigation of the Slope Failure at Clark Landfill

Prepared for

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East Chicago, Indiana

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TABLE OF CONTENTS

INTRODUCTION

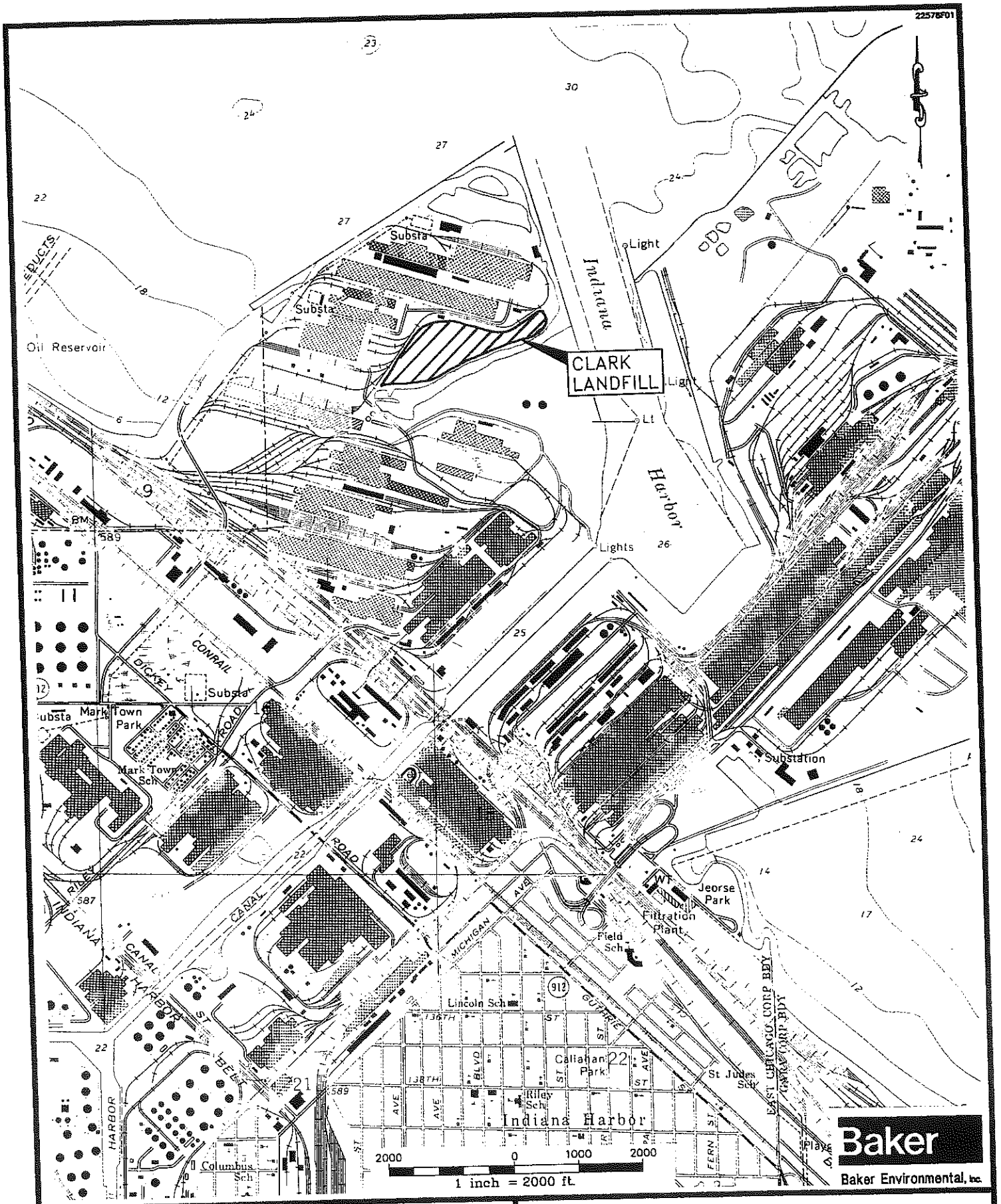
Currently and for many years, LTV Steels' Indiana Harbor works, located in East Chicago, Indiana, has been using an on-site disposal unit, known as the Clark Landfill, for disposal of solid (nonhazardous) waste. The Clark Landfill is located in the north central section of Indiana Harbor Works, just to the north of the intake flume from Indiana Harbor (see Figure 1).

On August 6, 1997 at approximately 8 a.m., the Clark Landfill experienced a slope failure on the southern side of the landfill parallel to the intake flume. Figure 2 shows the area affected by the slope failure. The scarp at the top of the slope was approximately 1,000 feet in length with a maximum vertical shear face of approximately 40 feet. The area of greatest apparent failure was in the southwestern section of the landfill slope. A portion of the slide mass, apparently consisting of slag from berms constructed in the early 1970's as part of the construction of the intake flume, has moved into the flume. As a result, sections of the intake flume are narrower and considerably shallower than that following the completion of the dredging program in 1996.

Immediately following the slope failure, the access road to the top of the landfill was blocked off and waste placement operations were diverted to the northwest end of the landfill, adjacent to the Clark Materials Handling Building.

Upon discovery of the failure, LTV notified the Indiana Department of Environmental Management (IDEM) and the National Response Center (NRC), citing the discharge of oil and potential for discharge of CERCLA hazardous constituents.

At 1:00 p.m. on August 6, a geotechnical engineer from Baker Environmental, Inc. (Baker) arrived at Indiana Harbor Works and conducted a preliminary site inspection. On August 8, 1997, an engineering team from Baker arrived on-site and began to conduct a detailed investigation into the cause of the slope failure and to develop/evaluate alternatives to:



LTV STEEL COMPANY
CLARK LANDFILL

FIGURE 1
SITE LOCATION PLAN

- Maintain (on an temporary basis) the water supply to LTV's No. 2 pump house which supplies service water to all operating facilities.

- Maintain (on a permanent basis) the plant water supply

- Close Clark Landfill

The following presents a summary of actions taken to date to investigate the cause of the slope failure.

SITE HISTORY

On August 28, 1989, LTV submitted an application for an on-site solid waste landfill interim permit for Clark landfill to the Indiana Department of Environmental Management (IDEM), in accordance with Solid Waste Management Rule 329 IAC 2-5-1(a), to allow continuation on-site disposal operations. Subsequently, the original submission was updated/revised by letters dated June 23, 1992, June 21, 1995 and April 3, 1996.

By letter dated May 20, 1996, LTV withdrew a Permit Application for a new landfill that was to replace the Clark Landfill. IDEM, in a letter dated September 4, 1996, acknowledged the withdrawal of the Permit Application and requested that LTV prepare a Closure/Post-Closure Plan for the Clark Landfill. By letter dated November 4, 1996, LTV submitted to IDEM a status report discussing closure activities completed and in progress. In addition, by letter dated _____, LTV submitted a conceptual closure plan design for review and concurrence.

A listing of closure activities conducted to date is summarized below.

- Performance of a landfill stability analysis
- Preparation of new topographic mapping
- Development of alternative final grading and cover plans

- Evaluation of closure alternatives and development of a conceptual closure plan
- Development of a staging plan for regrading of Clark Landfill

A brief summary of these activities is provided below.

Performance of Landfill Stability Analyses

The Clark Landfill is sited on land previously reclaimed from Lake Michigan and lies adjacent to the intake flume that is critical to plant operation. A slope stability analysis was warranted for the following reasons:

- The overall height of the landfill has increased with continued waste disposal activity.
- The landfill side slopes are relatively steep.
- The landfill is sited on foundation soils that consist of lake clays.

The work scope included a subsurface investigation (using both test borings and cone penetrometer testing) to obtain geotechnical information on waste and subsurface soil properties, laboratory testing of selected samples (i.e., Atterberg Limits, particle size analyses and soil classifications) to evaluate and classify the material comprising the landfill supporting stratum, and computer analysis to determine the critical failure surface (lowest factor of safety) for each section analyzed. The information obtained from the field investigation and stability analysis was essential in evaluating alternative final grading plans for the landfill and developing the conceptual closure plan for the landfill.

Preparation of Topographic Mapping

Topographic mapping of Clark Landfill was necessary for the following reasons:

- The latest available topographic mapping of the landfill was based on aerial photography taken on July 24, 1991 and, therefore, did not depict current conditions at the landfill.

- Mapping would facilitate the development of a final grading plan and performance of slope stability analyses.

- Mapping would permit more accurate estimates of required cover quantities thereby allowing development of more accurate construction cost estimates.

Survey control was established at the landfill during the week of July 22 and aerial photography was flown on July 27, 1996. Topographic mapping depicting the existing grades and slopes of Clark Landfill (as of July 27, 1996) was produced at a map scale of 1 inch = 100 feet and at a two-foot contour interval.

In addition, soundings of the intake flume were performed upon completion of the dredging program in 1996. These data were included in subsequent stability analyses.

Development of Conceptual Final Grading and Cover Plans

This task consisted of the following components:

- Reviewing IDEM regulations and policies on closure of interim status units.

- Developing alternative grading plans to achieve desired final landfill capacity requirements and final slope configurations that possess an acceptable Factor of Safety, while attempting to minimize excavation into the existing landfill wastes.

- Developing final cover/capping concepts that achieve long-term performance objectives of landfill covers.

- Preparing order-of-magnitude cost estimates for comparison of the various alternatives that include both initial construction costs as well as considering long-term maintenance requirements.

Cross sections through the landfill indicated that the existing exterior slopes are steeper than 2 horizontal : 1 vertical (2H:1V). The calculated Factor of Safety (F.S.) for existing slope stability on the intake flume side of the landfill ranged from 1.08 to 1.14 along three different cross sections.

Alternative grading plans were developed to address two major aspects of the existing landfill configuration:

- Achieving a minimum slope stability F.S. of at least 1.3 on the intake flume side for the final slope/configuration of the landfill.

- Maximizing the net remaining landfill capacity to allow landfill operations to continue through May 31, 1998.

Different capping concepts were devised to meet specific slope stability/maintenance constraints. The development of final grading concepts was an iterative process. Landfill height/slope configurations were revised/regraded and subsequently analyzed for stability. After several preliminary iterations, it was determined that a maximum slope of 3H:1V on the intake flume side of the landfill would achieve a minimum F.S. of at least 1.3.

Evaluate Closure Alternatives and Develop Conceptual Plan

Concurrent with the performance of the above task, several final grading concepts with capping arrangements differing based upon the steepness of the final slopes were developed. Slopes considered included 2H:1V, 2.5H:1V, 3H:1V and combinations (e.g., a steeper slope

on the land side than on the flume side). Three cover concepts were developed and are described below:

- Slopes up to approximately 3H:1V -- cover to consist of a textured geomembrane overlain by a vegetated soil layer.

- Slopes from approximately 3H:1V to approximately 2.5H:1V (relatively steep slopes) -- cover to consist of a textured geomembrane overlain by cover soil, 6 inches of topsoil to support vegetation and geogrid reinforcement to hold the cover soil in place.

- Slopes from approximately 2.5H:1V to approximately 2H:1V (very steep slopes) -- cover to consist of a geosynthetic clay layer overlain by an armored cover material.

Alternatives were evaluated on the basis of technical considerations and regulatory requirements. The alternative selected for implementation consists of regrading both the flume-side and the land-side slopes to approximately 3H:1V slopes and using a cap consisting of a geomembrane overlain by a geocomposite drainage layer overlain by a protective/vegetative layer.

Development of Staging Plan For Regrading of Clark Landfill

Baker prepared cut and fill contour drawings and cross sections to advise LTV's landfill contractor on grading activities required to establish landfill slopes in preparation of final closure which was anticipated to occur beginning in June 1998 when the landfill would reach final grade. Following submittal of the drawings, Baker conducted a site visit to review current operations and discuss future cut/fill operations, placement of grade stakes, and surveying activities. In addition, Baker personnel conduct periodic visits to verify and modify (as needed) grading and/or filling operations.

CAUSE OF THE FAILURE

Based upon the information currently available, a cause of the failure is not immediately identifiable. A factor of safety against rotational slope failure in the area in which the failure occurred (including additional fill located in accordance with the staging plan) was determined to be greater than 1.5. The average slope between the toe of the slope failure and the top of the scarp is approximately 3.5:1, which, based upon the known site conditions before the slide, should be stable.

The type of failure that occurred indicates the presence of a zone of soft material in or below the waste that was not identified by the borings installed in 1996, or a waste material strength significantly less than estimated based upon the results of those borings. Additional potential causes that were discounted include added loads to the slope (i.e., placement of more fill material on existing slopes) or removal of support material from the toe of the slopes. These causes were discounted because the contractor performing the staging of the material was locating the waste in accordance with the staging plan, as was verified by Baker during site visits, and because the final sounding of the intake flume (following dredging) were used in the development of the staging plan and stability analyses.

CURRENT ACTIVITIES

As indicated above, an engineering team arrived onsite on August 8, 1997 and began a detailed investigation into the cause(s) of the slope failure. Several actions were taken and consisted of the following:

- Surveying established "benchmarks" on a daily basis (subsequently changed to weekly after 10 days of daily recording) to assess whether the slide mass has stabilized.

- Performing sounding survey of affected portions of the intake flume.

- Acquiring new aerial photography and compiling new topographic mapping of the landfill (expected to be completed by September 19, 1997).

- Initiating a drilling program to install up to seven or eight borings through the landfill into the underlying foundation soils. These borings will be completed with soil samples for testing, slope inclinometer casing and piezometer wells.

- Initiating a testing program to determine the shear strength of the lake clay within and outside of the zone of failure.

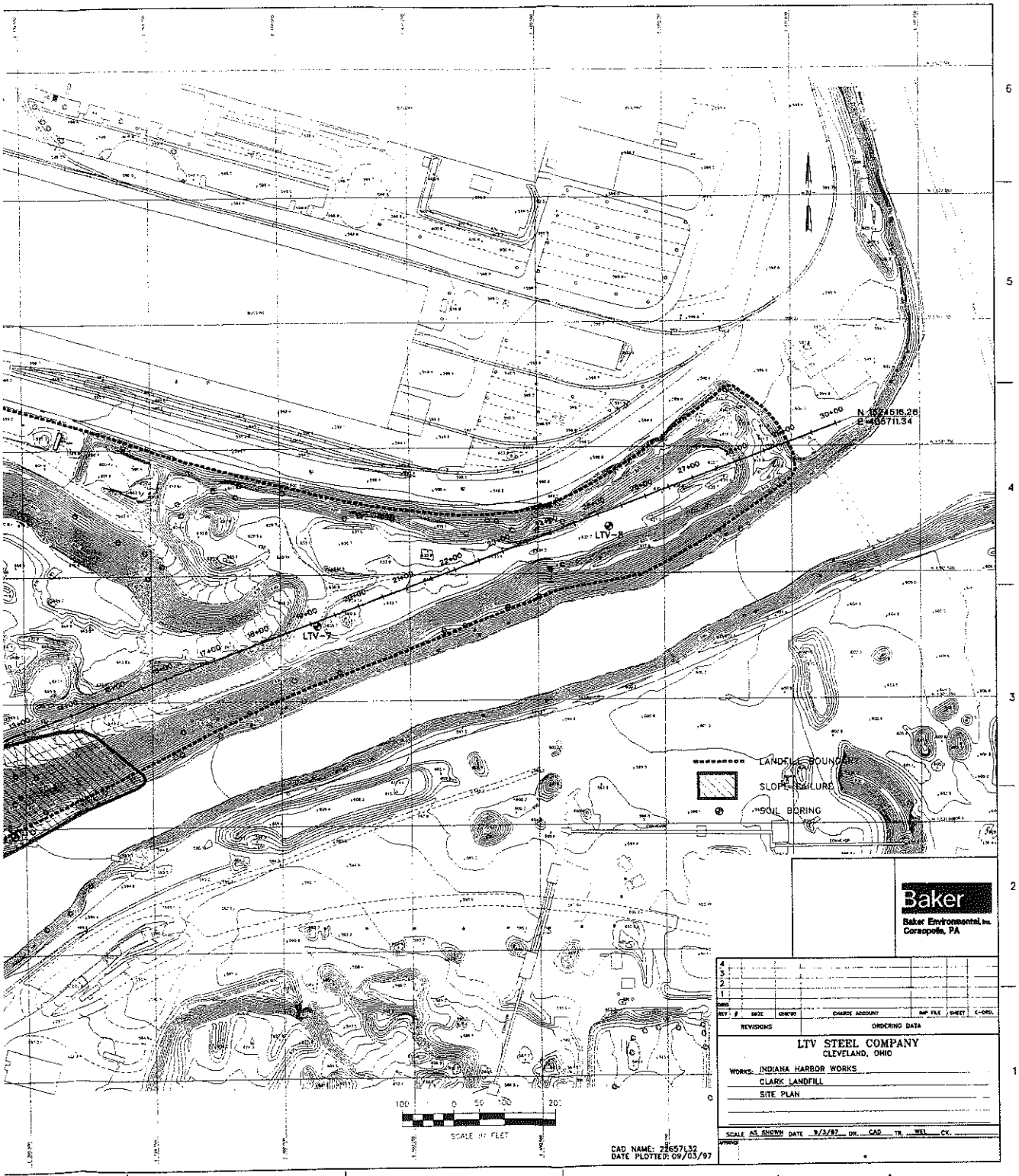
The landfill support activities are currently concentrated on identifying the cause of the slope failure. The daily survey information collected to date indicate that the slide mass has stabilized in its current configuration. There are cracks on the top of the landfill approximately 100 - 150 feet away from the scarp, but these are believed to a result of tension cracking from the loss of support at the scarp face, and are not believed to be indicative of a potential second major failure at this time.

Means of monitoring the area for another potential failure have been evaluated. It was determined that no method of monitoring and no action plan would be effective in identifying and combating a catastrophic failure. Therefore, all site personnel were cautioned to be vigilant in their observations of the existing scarp and cracks on the top of the landfill for indications that the area is shifting. These actions are being taken for protection of personnel working in the area (e.g., drillers installing the borings, inclinometers, and piezometers). In the event that conditions indicating that the slide mass has not stabilized (e.g., cracks widening, material raveling from the scarp face), all personnel will vacate the area and notify LTV.

The locations of the borings are depicted on Figure 2. Initially, soil borings are to be completed in the portion of the landfill that failed (i.e., LTV #1 through LTV #5). Following the installation of these borings, LTV #6 and LTV #7 will be installed. Boring LTV #8 will

be installed only if LTV #7 shows soft, unstable clay underlying the site at that location. Following the collection of these data, and the determination of the cause of the slope failure, a plan-of-action for the landfill will be completed and implemented, in a effort to ensure that the landfill can continue to be operated in a safe manner. In addition, until the cause of the failure is determined, no work will be performed on the slopes adjacent to the intake flume and no waste will be located near the failure area. The waste staging plan is being updated to reflect this.

In addition to these activities, an analysis of means to ensure the current water supply to the facility (including potential permanent intake system modifications) is being performed. Because the facility maintains a complex system of underground pipelines and utility supply systems, underground construction is difficult. The focus of this study is, therefore, on the flume as the construction corridor and utilization of the current pump house. Options under evaluation include pipe and backfill the entire flume length, pipe and backfill minimal flume length, restore open flume configuration, and use sheet piling to maintain open channel flume and backfill a portion of the slide area.



Baker

Baker Environmental, Inc.
Coraopolis, PA

REV. #	DATE	CHK'BY	CHARGE ACCOUNT	REF. FILE	SHEET	C-ORIG.
REVISIONS			ORDERING DATA			

LTV STEEL COMPANY
CLEVELAND, OHIO

WORK: INDIANA HARBOR WORKS
CLARK LANDFILL
SITE PLAN

SCALE AS SHOWN DATE 9/3/97 DR. CAD TR. WEL CK.
APPROVED

SCHEDULE

Installation of borings LTV #1 through LTV #5 will be completed and the slope inclinometers and piezometers installed by September 5, 1997. Borings LTV #6 through 8 (if required) are estimated to be completed by about September 19, 1997. The new topographic mapping (compiled from aerial photography obtained on August 22, 1997) is expected to be completed by September 19, 1997. Laboratory testing of samples submitted for analysis are expected to be completed by September 26, 1997. Completion of stability analysis is expected by October 3, 1997. Following the completion of the stability analysis, approximately two weeks are required to prepare a draft report findings and recommendations for LTV Steel review.

When the report review has been completed and a remedial action plan has been developed, LTV plans to hold an multi-agency meeting among Indiana Department of Environmental Management, Indiana Department of Natural Resources and the Army Corps of Engineers, to discuss the action plan. When a more definite time frame for this meeting has been established, LTV will contact each agency in advance and arrange for a meeting date acceptable to all parties.